Investigation of Deploying Unified Communications for Mosul University Network

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***ABSTRACT*:** *At present, the work of any modern organization, including Universities, uses a wide variety of communication technologies, such as instant messaging, email, voice mail, cellular phone, SMS, Traditional telephony, IP-telephony, video conferencing, and pager. Each means of communication has its own sets of features, and refusing to use any of them may reduce the efficiency. Each of these technologies requires different resources for implementation depending on the type of the technology. For the end user such variety means usage of multiple heterogeneous terminals and software. To improve the communication efficiency and to solve the problem of integration of various technologies, the concept of unified communications (UC) was developed. This paper presents the unified communications technologies and investigates the topology, infrastructure and resources for implementing unified communications system over Mosul University network. The work studies the ability to and types of UC technologies to be adopted for this network.*

Keywords: Unified Communications (UC), VoIP, Elastix

Received: 21 December 2011, Revised 29 January 2012, Accepted 4 February 2012

1. Introduction

The concept of Unified Communications (UC) appeared in the Information Technology (IT) world in the past few years. Before the emergence of unified communications, people were often required to decide in advance which communications modality they wished to use (voice, email, instant message (IM), web, or video) and separate communications channels for each were established. Unified communications integrate text communication services (such as instant messaging, presence information and e-mail) with voice and video communication services (such as telephony, IP-based Private Branch Exchange (IP-PBX), audio conferencing, voice mail and video conferencing) on a shared IP based communication network without the need for another communication networks such as traditional circuit switched telephone network. In another means unified communications integrate both real time and non real time communication services over IP based (packet switched) communication network.

So to implement this system over packet switched network, investigation of network topology, infrastructure and resources must be considered.

The new unified communications paradigm allows users to start with any communications modality they choose, and then

add any or all other modalities as needed, seamlessly. Unified Communication capabilities can also be integrated into nearly any business process or situation where human interaction or intervention is required [1]. UC is not a single product, but a set of products that provides a consistent unified user interface and user experience across multiple devices and media types [2]. Typically, UC solutions contain a set of core technologies illustrated in fig.1 [3] and listed below.

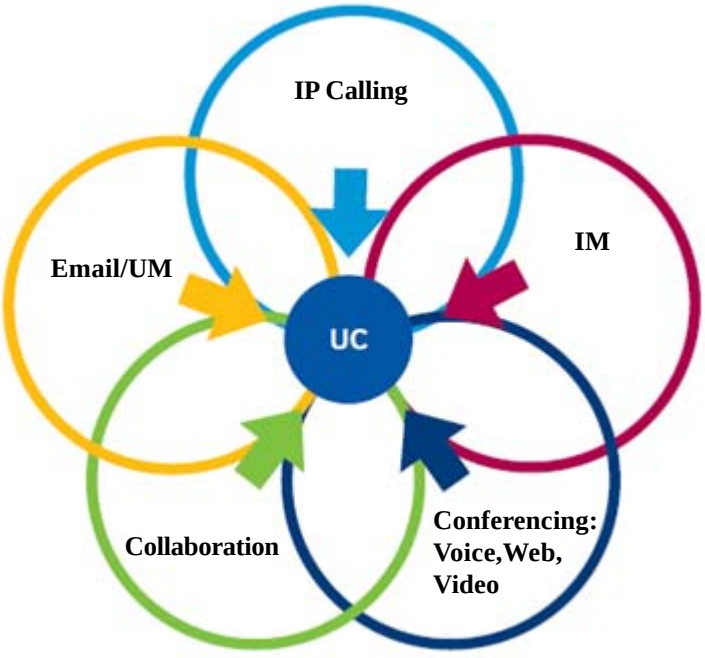

Figure 1. Unified Communication Technologies

1.1 IP Telephony

IP-telephony is a set of hardware and software that, together with VoIP technologies, enable voice communication over an enterprise using the IP as a native transport for voice and call signaling. IP telephony service is significantly less expensive to run than the previous PABX system. Specifically, the university can instantly move a staff member's extension, make changes to their phone status or add new users to the network. Video calling capabilities also eliminate the need for teachers, human resources and IT staff to travel between campuses, which saves time and reduces operational costs.

1.2 Presence

Presence represents the availability and willingness of a person to communicate. A simple example is the list of buddies you have in your instant messenger. When they are online (meaning they are available and willing to communicate), your instant messenger gives you an indication to that effect. Presence can also be enhanced to show where you are and how (since we are speaking about integrating many communication tools) you can be contacted. For example, if a buddy is not in his office or in front of his computer, there is no way your instant messenger can have you contact his, unless other communication technologies are integrated, like pc-to-phone calling. With unified communications, you can know where your buddy is and how you can contact him.

1.3 Conferencing

Colleges and universities realize that they need to tap the talents and expertise of intellectual leaders around the world, and to form partnerships with private industry as well as their academic peers. Audio, video and Web conferencing provided by unified communications are a cost-effective alternative to travel, making it easier and less expensive to share ideas, create and maintain partnerships, and to recruit top students, faculty and staff.

1.4 Collaboration

Effectively sharing information across and among workgroups, internal and external to a university, using all communications media [4].

1.5 Unified Messaging (UM)

UM is the integration of voice mail, email, fax mail, and pages through common interfaces. UM allows users to access any of these messages, anywhere, anytime, from any terminal.

2. Unified Communications in University Environment

Sharing and developing ideas is at the core of what a college or university does. Students, faculty and staff share ideas with each other and with outsiders by exchanging data such as research results or through conversations. These exchanges may take place in the same room or across countries or continents. The more easily ideas can be shared, the better the experience for all the key players in the academic environment. The less expensively this idea sharing can take place, the more resources a college or university has for its core mission.

To facilitate this information sharing, colleges and universities have historically maintained separate networks and separate management staffs for voice and data traffic. This made sense until the emergence and widespread use of IP (the Internet protocol) made a new unified communication model possible (merging voice and data on a single, IP network).

This convergence greatly reduces and simplifies what had been the cumbersome job of architecting, managing and maintaining multiple campus-wide networks. It allows network managers to use their existing IP skills to facilitate the movement of data and voice, rather than having to hire and train separate staffs for each type of traffic. It allows an institution to get the maximum benefit from its existing network infrastructure, reallocating bandwidth between voice and data as user needs change, while eliminating the costs of managing and maintaining separate networks for voice and data.

A unified communication system also enables the rollout of new applications such as distance learning and video conferencing, which can reduce travel costs and allow the school to reach more students in more locations.

In today's environment, we observe community college and vocational education campuses moving towards a model that makes it convenient for the students to attend by not traveling to a central campus. This requires many smaller locations that still require the network facilities and voice communications features of the main campus. For this reason, it is important to have a unified communication architecture that allows uniformity in features and dialing as well as providing a high level of availability.

Unified communications in university campus can help educators, administrators, and staff members streamline communication regardless of medium, platform, device, or location. Users can stay in touch and get work done wherever they are using whichever device is most convenient. Unified communications in university campus can break down silos and extend existing communications investments. The benefits of deploying UC system include:

- The integrated IP telephony, voicemail and email service is significantly less expensive to run than the previous PABX system and separate email platform.
- Enable staff to get more facilities by giving them easy access to email, calendaring tools, voice mail, and instant messaging (IM) through multiple devices, so they can communicate with each other in different ways.
- Make it easier to collaborate with colleagues at different campuses or schools, using audio/video web conferencing technologies.
- Allow staff the mobility to spend more time with students, parents, and colleagues.
- Simplify IT management by using single technology architecture
- Simplified network design allows reduction in support costs and increases in network stability and uptime.
- Provide the levels of reliability, availability, and scalability to manage your university services.
- Enhancing the capability for the staff and students to access to the international libraries and references.

3. Unified Communications Server

Unified communications system support and integrate different communication technologies, to manage the integration of UC technologies, UC server is required. The unified communication software offers the required management for successful

multimedia transmission over a single network. A large number of Unified Communications software is offered. Magic Quadrant for Unified Communications represents the unified communication companies as a graphical representation. Fig. 2 illustrates the magic quadrant for unified communications as of August 2011.

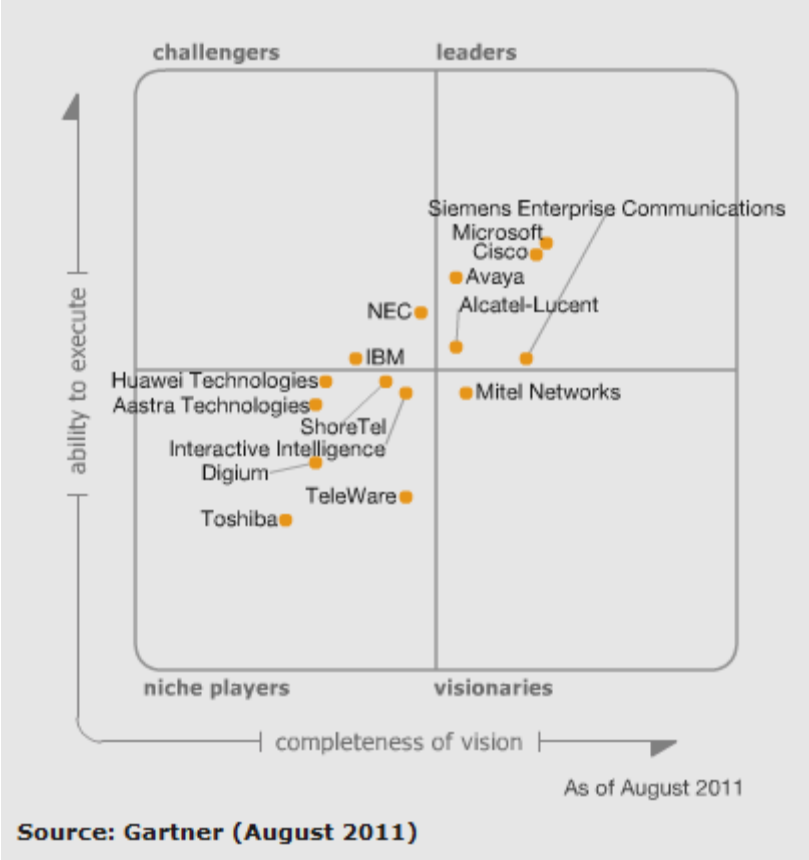

Figure 2. Magic Quadrant for Unified Communications

From a competitive, in the Leaders quadrant, Cisco and Microsoft maintained their strong leads. Cisco advanced a more integrated approach with its UC 8.x release. It also successfully integrated its existing video solutions and the Tandberg acquisition, clarified the WebEx options and released its Jabber client. Microsoft released Lync (an evolution of its OCS product) and enhanced its telephony capabilities. Microsoft now has referenced that use only for telephony, which is an important milestone. Microsoft also made important UC as a service (UCaaS) advanced with the release of Office 365, which includes Lync-Online. Microsoft's pending acquisition of Skype is likely to lead to Skype-integrated Lync offerings [5]. Table 1 illustrates Cisco and Microsoft unified communications software and the supported features for each company.

IBM entered the unified communications marketplace with several products, beginning in 2006 with the updated release of a unified communications middleware platform, IBM Lotus Sametime 7.5.

Until Mar 2008, there are several open source projects with a Unified Communications focus such as Elastix.

Elastix is based on Asterisk, a leading open source telephony project. Asterisk is a Linux based IP PBX application developed by Mark Spencer of Digium, the company behind Asterisk. Elastix evolved from the core Asterisk 1.4. It is made up of several major components [6]. It consists of applications, a provisioning system, an installer, and an operating system that, together, make a complete package ready for use as a unified communication server. Some features are provided by Elastix software such as Voicemail, Conferencing, Instant Messaging, Interactive Voice Response, Call Queuing, Caller ID Services, SIP VoIP Protocol, H323 (as a client & gateway), IAX, MGCP (provide call manager function only), SCCP/Skinny. Figure 3 illustrates UC features integrated by Elastix [7].

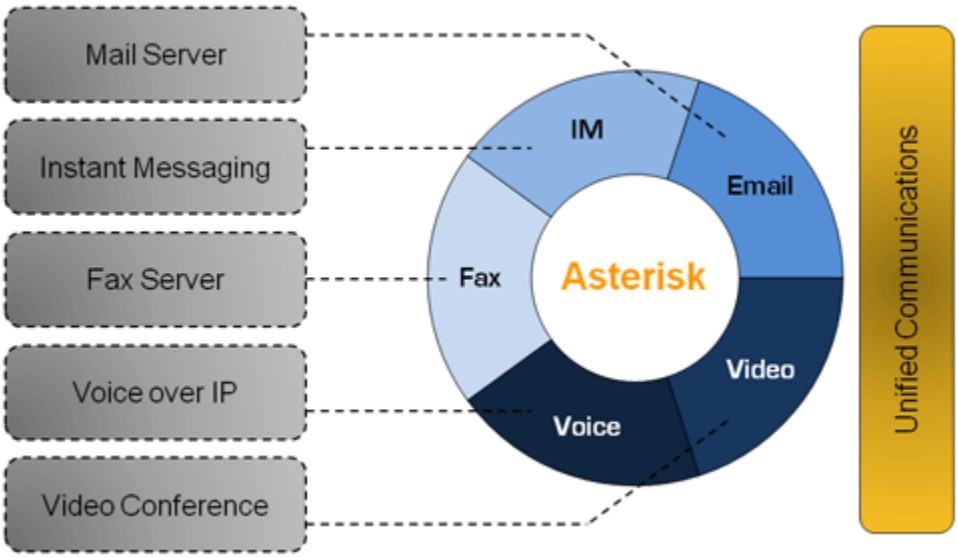

Figure 3. Elastix features diagram

Elastix implements a great deal of its operation on four very important programs, which are Asterisk, Hylafax, Postfix and Openfire. These programs respectively give the PBX, Fax, Email and Instant Messaging functionality. The operating system is based on the popular Linux server-focused distro called CentOS.

Unified Communication Company	Software	Features
Cisco	Cisco Unified Communications Manager 8.0 Cisco Unified Presence 8.0 Cisco Unified Personal Communicator	Audio Conferencing, Video Conferencing, Presence, Messaging, Call Center and VoIP
Microsoft	Microsoft Lync Server 2010 Microsoft Lync Exchange 2010 Microsoft Lync client	Presence management, conferencing, Instant messaging, Unified messaging, VoIP, Secure communication and Mobility

Table 1. Unified Communications Software

4. Requirements For Deploying Unified Communictions Network

Unified Communications offers the vision of a single IP network, carrying traffic from many different types of applications (voice, video, and data). Each type has different characteristics and requirements. For example, a file transfer application requires that some quantity of data is transferred in an acceptable amount of time, while IP telephony requires that most packets get to the receiver in less than 0.3 seconds. If enough bandwidth is available, best-effort service fulfills all of these requirements. When resources are scarce, however, real-time traffic will suffer from the congestion. To successfully integrate real time with non real time communications over IP based network that UC adopt, the following components are required to build a Unified Communications network:

4.1 Unified Communication Server

The core unit of Unified Communications system is Unified Communications software. The unified communication software

supports the following features:

4.1.1 Quality of service (QoS)

To truly assure application experience over campus network, QoS is a key requirement. It is critical to assign and manage QoS levels in order to ensure satisfactory performance of the various software applications including unified communication applications that are sensitive to jitter, packet loss, and latency. A minimum of three levels of QoS are requiered each determines a priority for applications and resources, such as:

- Real-time
- Business critical
- Best effort

4.1.2 Voice over IP Signaling protocol

VoIP standards define numerous signaling protocols that are used to set up and carry out the calls, transmit information required to identify and locate remote callers, and negotiate carrier and endpoint capabilities. Different companies developed numerous different signaling protocols within the VoIP scope. SIP and H.323 are dominating the VoIP arena as the most commonly used signaling protocols. Choosing one signaling protocol over another when developing a VoIP solution is a matter of a set service requirement and the choice of equipment.

4.1.3 Codec Software

A Codec is a software that converts audio signals into digital frames and vice versa. Codecs are characterized with different sampling rates and resolutions. Different codecs employ different compression methods, using different bandwidth and computational requirements.

There are different codecs available to use for connecting voice calls from one VOIP endpoint to another. These different encoding-decoding methods have different call qualities and different bandwidth requirements. Basically, if you want your calls to use less network bandwidth, then you will suffer reduced call quality. The low-bit-rate codecs use a lot less bandwidth and will save you money on your network links.

4.2 VoIP Gateway

A VoIP Gateway is a network device that used to convert voice and fax calls between an IP network and Public Switched Telephone Network (PSTN) in real time. VoIP Gateway is used in two ways:

- To convert incoming PSTN telephone lines to VOIP.
- To connect a traditional PBX Phone system to the IP network.

4.3 End Points (Client Devices)

The access points for users are for the purpose of taking advantage of UC applications. These can be IP phones, personal digital assistants (PDAs), mobile phones, and applications for personal computers such as softphones.

5. Unified Communication For Mosul University Network

Mosul University central campus includes two major infrastructure networks:

5.1 Traditional Circuit Switched Telephone Network

Panasonic phone system support the analog telephony service, this network consists of:

- Main exchange (Panasonic KX-TDA600).
- Sub exchanges with less capacity (KX TDA200).
- PSTN (Public Switch Telephone Network) lines feed the exchanges as direct lines.
- Analog telephone devices (KX-TD600).
- Underground copper cables network distributed in the campus connecting all buildings.

5.2 IP Based Local Area Network (LAN)

The current usage of Mosul University local area network is to distribute the Internet service from the central communication office to all buildings and colleges in the campus. The distributed medium for this network is fiber optic cable, the fiber optic cable transfer the data as a light signal with high speed rate. The figure bellow shows the layout for the optical fiber network in the central campus of Mosul University.

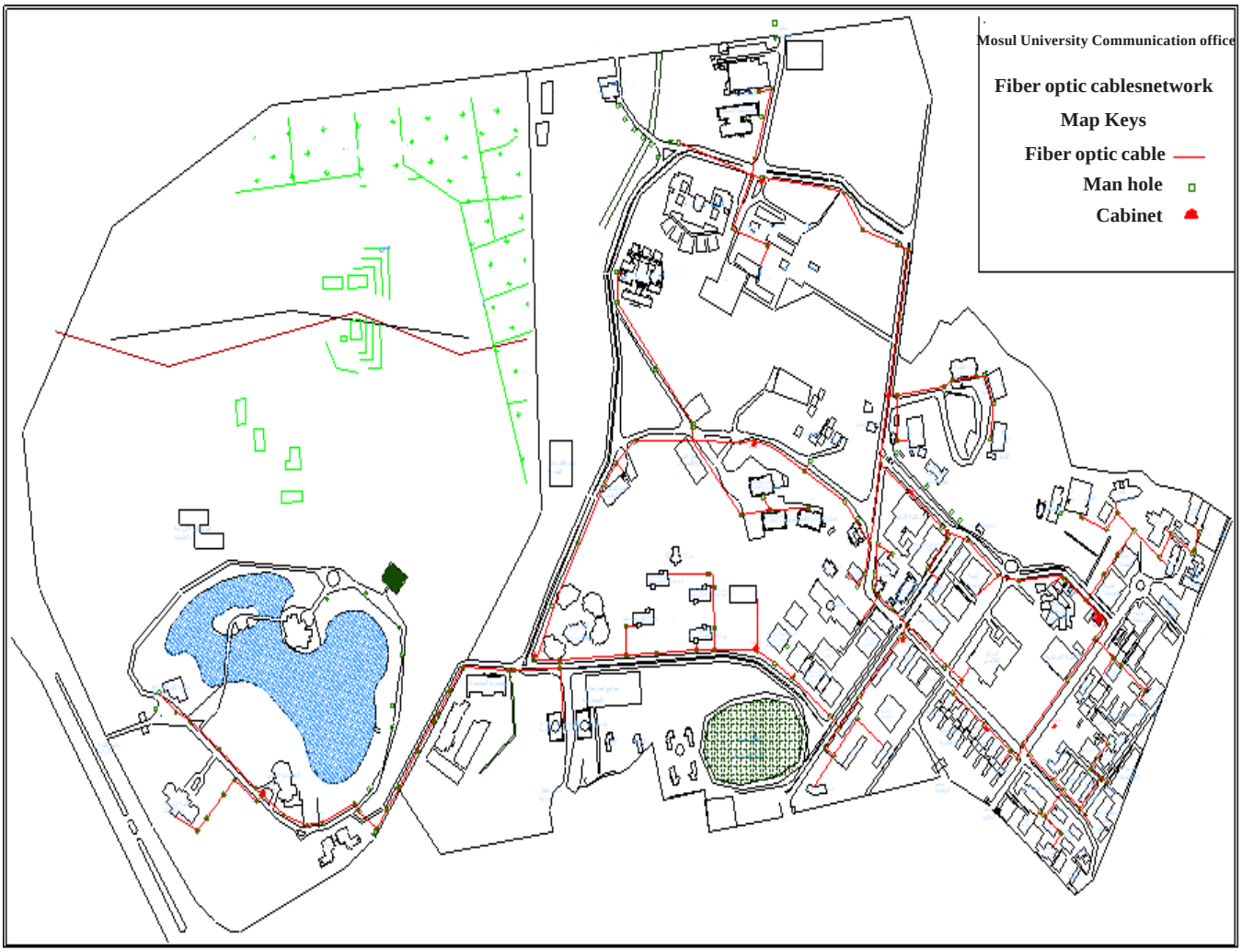

Figure 4. Underground fiber optic cable layout for central campus

To enhance the communication between users in the campus, additional services can be added to this network such as voice over IP, Instant Messaging, E-Mail and Conferencing. The better solution to add these services to the existing LAN is the unified communication system.

Elastix UC server is suitable to provide services for users within the university campus. The main advantage of deploying Elastix server is as open source software.

6. Unified Communication Implementation

The suggested unified communication network for Mosul university central campus is shown in fig. 5. UC server realizes VOIP, virtual fax, voicemail, video conference and voice call between IP phone and traditional analog phone via VoIP/TDM gateway connecting UC network with the PSTN. So, the users can enjoy these functionalities via PC, portable PC and mobile, telephone, client software according to its demand.

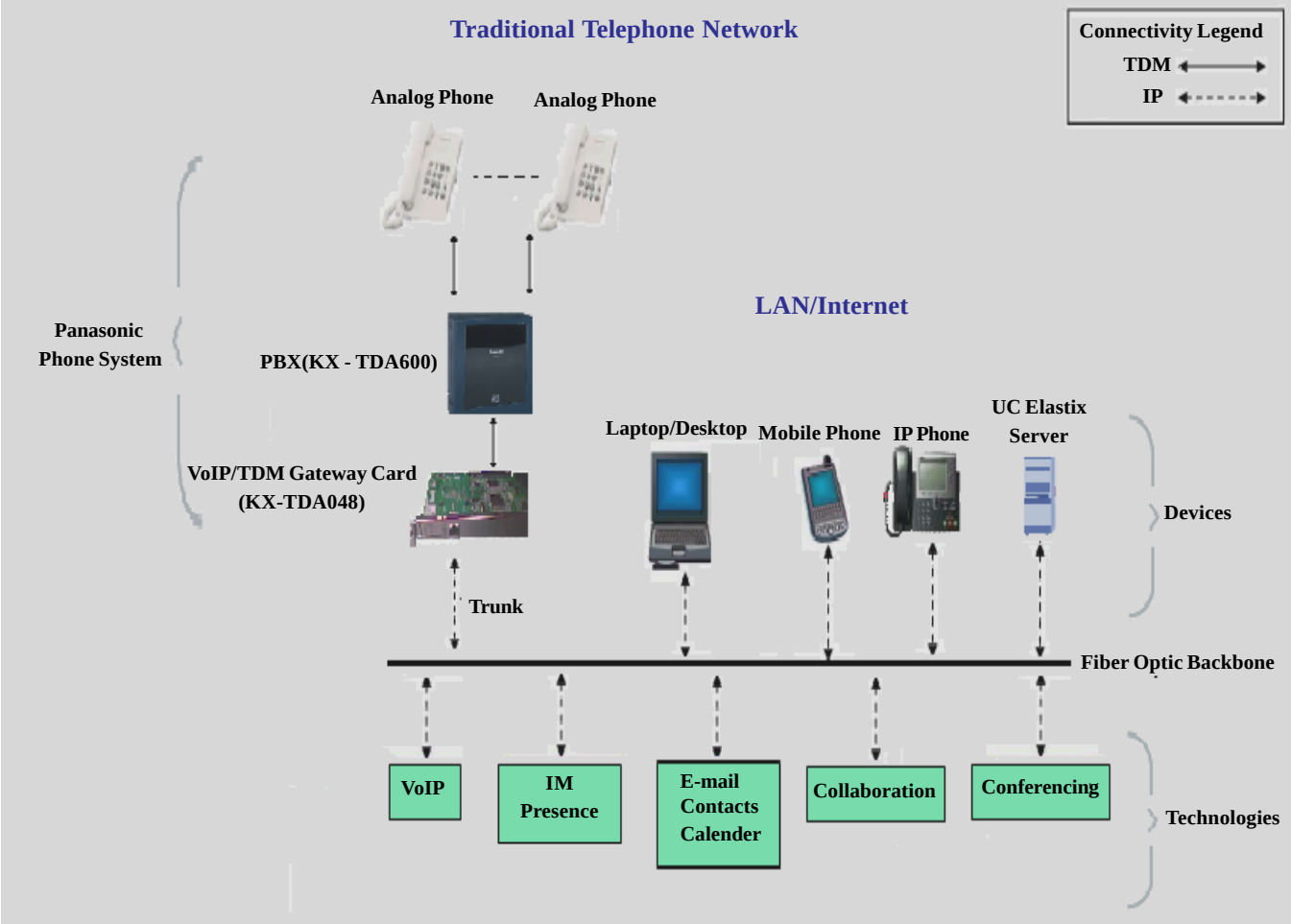

Figure 5. UC network for Mosul University

Elastix server must be configured to work as a UC server, according to the following steps:

6.1 Download and Installation

Free download Elastix version 2.2.0 ISO image is avaliable at Elastix websit (http://www.elastix.org), this download can be burned as image on blank CD and then installed on Pc or server. The minimum hardware requierments to install Elastix for small office envirement is [8]

1) Pentium III PC or better (P4 will give extra comfort).

2) 312MB RAM.

3) 8GB minimum hard disk space.

4) 10/100 NIC.

5) CD-ROM Drive.

Naturally if Elastix is running in a heavy environment, heavier duty and better specification system are needed.

In the installation process, required information must be assigned such as root password, network configuring (static IP address, default gateway address and domain name service address) and other relevant information.

UC server for Mosul University network has the following specifications:

1) Pentium 4 PC.

2) 2GB RAM.
3) 160 hard disk space.
4) 10/100 NIC.
5) CD-ROM Drive.

6.2 SET-UP ELASTIX

After assigned Elastix IP address, we can configure Elastix server remotely from another device by using the web browser connecting to https://Elastixipaddress/. Using the GUI interface for configuration make it possible to configure Elastix easily without using Linux commands.

6.3 Configure Elastix PBX

To start configuring the IP PBX portion of Elastix, select and click on the PBX group tab and we will be presented with the PBX Configuration screen featuring embedded freePBX. For this system, we will simply use the standard default modules using embedded freePBX.

6.1.1 ELASTIX Extension

It is implemented by Flex that accesses directly MySQL for Elastix. But it can not take effect instantly when an extension is new created. We must flush the change into data base of Asterisk by extension management on web menu. There are a number of device types for the extensions, e.g. SIP, IAX2, ZAP or Custom. 10 SIP extensions (3000-3009) are created for test purpose.The number of SIP extensions that must be created is depending on the number of users.

6.1.2 ELASTIX Voicemail

To enable voicemail on an extension simply “enable” it when you create the extensions or it may be added later on when you decide that the extension requires a voicemail. If the user does not respond to a specific call, a voice message can be left to this user.

6.2 Set-Up Softphones

There are a number of softphones available for use with Elastix. X-Lite is a proprietary freeware VoIP soft phone that uses the Session Initiation Protocol. X-Lite is developed by CounterPath Corporation. SIP based call signaling allows X-Lite to work with a wide number of networks. After installing the softphone (assuming that users can install the softphone), fields of the softphone must be configured as follow:

 # Display Name: ***User Name***

 # User Name: ***Extension number***

 # Password: ***The password of the extension***

 # Authorization User name: ***The same as extension number***

 # Domain: ***Elastix IP address***

6.3 Set-Up VoIP Trunk

A trunk is the telephony service line that can be used to make an external call. SIP trunk is configured for transferring calls between the UC network and the PSTN.

6.4 Set-Up Elastix IM

Under the IM tab in Elastix, a product called Openfire is found. In simple terms, Openfire is a very popular Messaging (Chat) and Presence Server, that uses the Jabber/XMPP protocol. To connect Openfire Server to Asterisk system, Asterisk-IM-Openfire Plugin must be installed, we can download this plugin by clicking on update now hyperlink in the available plugins tab and install it. All we need to do now is create an account for each user and install the client software on the desktops. Username and Password are required to create a new user account.

The most popular client software to work with Openfire server is Spark software. The following information is required to setup Spark on the client desktop.

Username: *Log in Name*

Password: *The password that you setup for that user*
Server: *The IP address of Elastix server*

7. Conclusion

Generally, it can be concluded that the infrastructure of the University of Mosul network is capable of deploying Unified Communications.

In addition to the Internet service provided currently by this network, UC will add VoIP call, voicemail, instant messaging, conferencing and Email services to the University network. The benefits can be summarized as follows:

• Improved communications between staff members across the university campuses.

• Saving time and reducing operational costs by introducing different types of calling capabilities.

• Enhancing the video conferencing service.

• Provide a more effective and productive means of interacting with others.

• Enhancing the capability for the staff and students to access to the international libraries and references.

• Provide reliability for delivering the data.

• UC will support the employments of e-government and e-learning that the university is going to adopt.

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